EXPLANATION OF PLATES XV.–XVII.

Skulls of Moas one-half the natural size.

PLATE XV.

Fig. 1 and 1a. Dinornis potens; after Owen, Ext. Birds of N.Z., pl. lxiv.
Fig. 2 and 2a. Dinornis (Tylopteryx) torosus; after Owen, Ext. Birds of N.Z., pl. lxxii.
Fig. 3 and 3a. Palopteryx dromicioides; after Owen, Ext. Birds of N.Z., pl. xlv.
Fig. 4 and 4a. Anomalopteryx didiformis; after Owen, Trans. Zool. Soc., vol. xi., pl. lii.

PLATE XVI.

Fig. 5 and 5a. Cela curtus; after Haast, Trans. Zool. Soc., vol. xii., pl. xxxi.
Fig. 6 and 6a. Syornis crassus; after Owen, Ext. Birds of N.Z., pl. lxxvi.
Fig. 7 and 7a. Mesopteryx didimus; after Owen, Ext. Birds of N.Z., pl. lxxvii.
Fig. 8 and 8a. Eurypteryx ponderosus; after Owen, Ext. Birds of N.Z., pl. lxxviii.

PLATE XVII.

Bones of Anomalopteryx antiquus, from the North Mole Quarry, Timaru: a, right tibia, anterior aspect; b, left tibia, inner aspect; c, right metatarsus, proximal end; d, left metatarsus, distal end. The three other large fragments imbedded in the matrix are portions of the pelvis.

ART. VI.—Notes on Moa Gizzard-stones.

By A. HAMILTON.

[Read before the Otago Institute, 10th November, 1891.]

Some little time ago I had the pleasure of seeing, through the kind offices of Mr. F. R. Chapman, some very remarkable traces of the moa, and I propose to offer to the society a short description of these interesting relics.

Mr. Chapman, in a paper communicated to this society in 1884,* described several collections of gizzard-stones examined by him in that year; and, as he had also noticed somewhat similar traces on the elevated plateau of Swampy Hill, in the neighbourhood of Dunedin, we took an early opportunity of examining the ground more closely. The surface of the range is here swampy moorland right up to the very verge of the precipitous declivities into the valley of the Water of Leith, and the mossy surface abounds in small lagoons, some of which have been considerably reduced in area by drains cut in various directions. The altitude is about 2,000 ft., and the

SKULLS OF MOAS.
1/2 nat. size.
From a Photograph.

BONES OF ANOMALOPTERYX ANTIQUUS.
From the North Mole Quarry, Timaru.
vegetation consists of small and inconspicuous plants, with occasional patches of manuka. In some places a space of ground of nearly an acre is completely bare, and by the sections exposed is seen to be solid vegetable peat, which in many places is certainly of a depth of 10 ft., and probably even 20 ft. The cause of these bare patches, devoid of any surface vegetation, may be either that, the water of a pond or lagoon has been drained away, or that fire has burned a certain part away in the dry seasons; but, whatever the cause, on these barren areas are seen heaps of unmistakable gizzard-stones of pure-white quartz. In the majority of cases it is not possible to isolate absolutely the total contents of one gizzard, but we were fortunate enough to find at least two examples which would convince even the most sceptical as to the real character of the heaps more or less scattered on the ground.

The first of these was just being exposed by the action of the weather from underneath a clump of manuka, and only a few of the larger stones were visible. On digging into the peat we noticed that, although the interstices between the stones were filled up with closely-interlaced vegetable fibres, similar in substance to the rest of the peaty soil, yet it was of a decidedly yellow colour, in contrast to the brown of the peat. The stones were found to be closely compacted together in a ball-shaped mass, and were of all sizes, from those less than a pea to those larger than a pigeon’s egg. We carefully cut out this mass, which was as large as a man’s head, and could find no stones in the peat immediately surrounding the collection. The stones were carefully washed out and dried, and tied up in a separate bundle, and on weighing them afterwards they were found to turn the scale at 44 lb.

The second example was on lower ground close to a large lagoon, and only a few small stones were visible. Packed in between the stones was the same comminuted vegetable matter of a much lighter colour than the surrounding peat. This mass we removed as carefully as possible and tied it up separately. I have picked out most of the stones, and dried and examined the vegetable matter in which the stones are imbedded and interwoven, and I find it to consist of vast numbers of seeds of Leucopogon and Coprosmas (?), and short twigs and branches which cannot be well identified. Some of the material I have forwarded to Mr. T. Kirk for examination and identification.

The number of stones in these two gizzards must far exceed those described by Mr. Chapman in his paper. In the second example the weight of the stones was just six pounds.

Still continuing our walk over the bleak and barren moorland, we saw unnumbered scattered heaps of these white-
quartz pebbles, and in one place more than a barrowload of them. This heap must have weighed over a hundredweight at least, and could only have resulted from the destruction of numbers of birds crossing some unusually soft or treacherous part of the swamp during a long series of years; or they may have been gathered together by flowing water, and deposited in a hole at the bottom of some channel or pool on the surface of the peat, and subsequently exposed by changes of level and subaerial action.

Near this great heap two curious observations were made: one was, on cutting into the peat for a few inches we came to a "pocket" of clean, sharp quartz-sand—about a pint, just like sea-shore sand—with a few small pebbles in it. This could not possibly have been deposited where we found it by any natural physical agency. Mr. Chapman, I believe, met with a similar small pocket of sand on the top of Maungatua, on the south side of the Taieri Plain, at the height of about 3,000 ft.

The other find was the proximal end of a metatarsal bone of a moa of medium size (possibly D. crassus), almost entirely decalcified. This was the only fragment of bone which the most rigorous search could find, and Mr. Chapman informed me that on a previous occasion he had found a similar fragment in the same condition. Now, I had always supposed peat-swamps to be the happy hunting-grounds for the bone-hunter, and was much disappointed at not finding any trace of the birds which used all these gizzard-stones, and I constructed several ingenious theories to account for the matter, some of which fitted the facts delightfully; but on testing the samples of peat which I took home I found that ordinary litmus-paper was immediately reddened when placed in contact with the peat.

Here, then, was the explanation of the mystery—the strongly acid character of the decaying vegetable matter dissolved the bones entirely; and, instead of the peat-deposit of Swampy Hill turning out either a Glenmark, Hamilton, or Enfield, only the imperishable quartz pebbles contained in the gizzard have remained to testify to the former abundance of Dinornithidae in that part.

On looking up the subject of peat, I find that Sir Charles Lyell* says, "The antlers of large and full-grown stags are among the most common and conspicuous remains of animals in peat. They are not horns which have been shed, for portions of the skull are found attached, proving that the whole animal perished. But as a general rule no remains are met with belonging to extinct quadrupeds, such as the elephant,

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rhinoceros, hippopotamus, hyaena, and tiger, which are so common in the old European gravels.” This extract seems to confirm the destructive properties of peat; and I believe that all the remains of the Irish elk from the bogs of Ireland are from the clay- or marl-beds immediately at the base of the peat.

Since writing the above I have seen large peat-deposits in Southland at a much lower level. In one place, at the Mararoa Station, near Mount Excelsior, the peat has been regularly worked for years for burning. Here also moa-stones occur in profusion. The process of cutting also exposed the fragments of perished bones. I carefully examined this deposit, and found it to consist almost entirely of Caloropus; and the Sphagnum which forms the majority of peat-mosses in England was entirely absent.

I should have mentioned above that the nearest place at which the quartz pebbles could be procured is at the outcrop of the Otago schist formation, distant from Swampy Hill about four miles. The weight of the largest stone in the two collections is a little over 1½oz.

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ART. VII.—On the Genus Aptornis, with more Especial Reference to Aptornis defossor; Owen.

By A. HAMILTON.

[Read before the Otago Institute, 8th November, 1891.]

As long ago as the year 1842 Dr. Buckland received from New Zealand a collection of moa-bones from the east coast of the North Island, forwarded to him by the Rev. W. Williams. On examining this collection Professor Owen found ample confirmation of his previous determination of the cursorial character of the specimens on which he had founded his genus Dinornis in the year 1839.

Among the bones in this collection he found a tibia: “which unequivocally establishes a fourth species of Cursorial bird which, from the agreement of the bone in its general characters with the tibiae of the larger species, most probably belonged to the same genus—Dinornis—but did not surpass in size the great bustard” (Otis tarda). This species the Professor named Dinornis otidiformis (1843).

Time passed on, and further collections of bones were made in New Zealand and sent Home (1846), and in the memoir on the genus Palapteryx a fragmentary femur is allotted to the